

# **Results of the Investigation into the Allegations about Kashiwazaki-Kariwa Nuclear Power Station Units 6 and 7, and Steps to Be Taken Going Forward**

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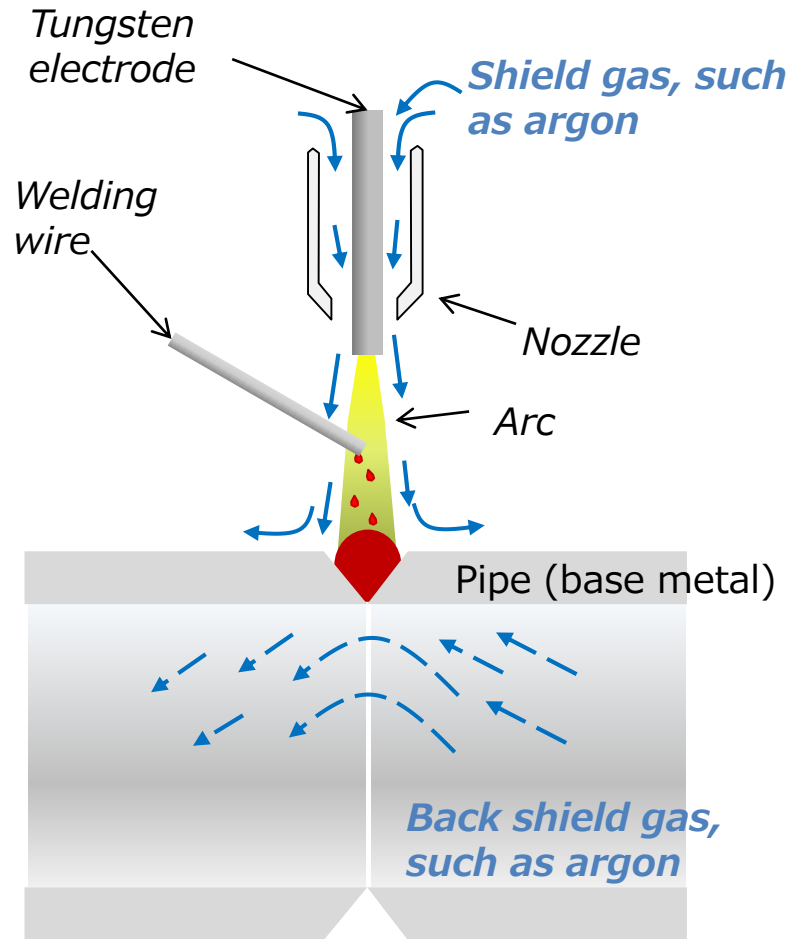
December 24, 2021

Tokyo Electric Power Company Holdings, Inc.  
Kashiwazaki-Kariwa Nuclear Power Station

# 1. Background to date

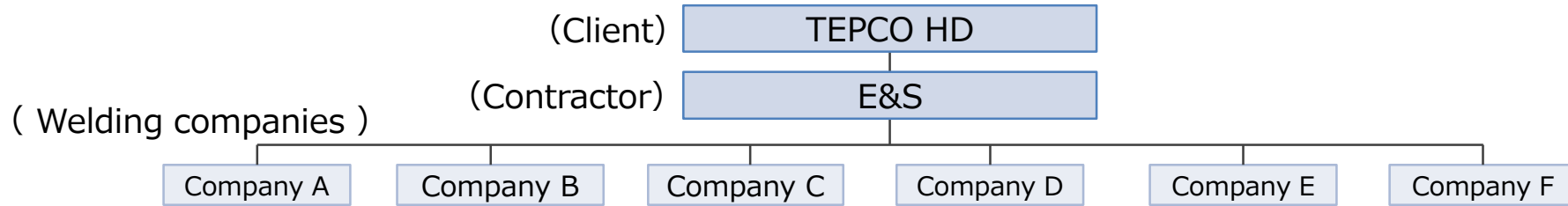
- After March of this year, an anonymous letter was sent to TEPCO Energy Partner, Inc. alleging that, "a subcontractor (Company A) of Tokyo Energy & Systems, Inc. (hereinafter referred to as, "E&S") is welding fire suppression system piping at Kashiwazaki-Kariwa Nuclear Power Station Units 6/7 without back purging ※."
  - ※ Back purging refers to flooding a pipe with an inert gas (such as argon) that acts as a back shield to prevent oxidation on the inside of the pipe during the welding process.  
Back purging is stipulated by Japanese Industrial Standards (JIS) and used when welding stainless steel pipes together.
- TEPCO ordered the general contractor, E&S, to confirm the validity of these allegations, and also conducted its review and assessment of the investigation.
- The investigation found the following three points, and also that 30 welds in Unit 6 fixed fire suppression system piping were defective, as alleged in the anonymous letter.
  - ① An investigation of the inside of pipes using a fiber optic scope found welds that do not satisfy specifications.
  - ② Interviews yielded testimony that back purging was not being conducted during welding.
  - ③ Welding records had been falsified to show that back purging had been conducted.
- Therefore, both general contractors that have been contracted to work on the Unit 6 fixed fire suppression system (KK6 Safety Measures Joint Venture Corporation) and the Unit 7 fire suppression system (E&S) were instructed to continue their investigations.

[\(Announced on July 30, 2021 \(Japanese text only\)\)](#)



- When welding pipes, melted weld metal is built up in the groove on the outside of the pipe.
- On the outside of the pipe where the welder is, a shield gas continuously flows into the weld to purge oxygen from around the arc (electrical spark) being used to melt the metal.
- During welding, part of the pipe (the base metal) is also melted which means that the metal on the inside of the pipe, which has been heated to high temperatures, comes in contact with the gaseous environment inside the pipe where the shield gas cannot reach.
- If there is oxygen inside the pipe, the inside of the pipe will oxidize, so the pipe is flooded with a back shield gas in order to purge the oxygen.

### [ Unit 7 fixed fire suppression system pipe welding team: From E&S's report ]



### [ Investigation of Company A mentioned in the allegations: From E&S's report ]

- Interviews (Performed by E&S※)
  - ✓ 17 welders and 5 welding assistants interviewed
- Pipe internal investigation (Performed by E&S, assessed by a third-party (Japan Power Engineering and Inspection Corporation (hereinafter referred to as, "JAPEIC")))
  - ✓ Investigation method: A fiber-optic scope was used to perform a visual inspection of the inside of the pipes
  - ✓ Number of welds inspected: 194 (Number of welds done by Company A: 1,220)

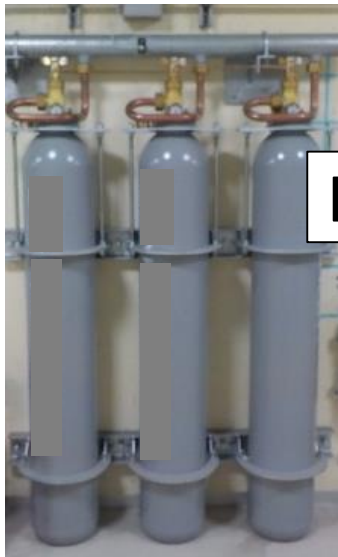
### [ Investigation of Unit 7 fixed fire suppression system piping welds (companies B~F): From E&S's report ]

- Interviews (Performed by E&S※)
  - ✓ 38 welders and 1 supervisor interviewed
- Pipe internal investigation (Performed by E&S, assessed by a third-party (JAPEIC))
  - ✓ Investigation method: A fiber-optic scope was used to perform a visual inspection of the inside of the pipes
  - ✓ Number of welds inspected: 1,673 (All welds done by companies B~F)  
(The 953 welds done by Company F were done at the factory and were subject to quality control inspections prior to shipping, so these welds were omitted from the investigation)

※ Interviews with persons of interest were conducted in the company of personnel from E&S's legal department, attorneys hired by E&S, TEPCO employees and attorneys hired by TEPCO

### What is the fixed fire suppression system?

- A fire suppression system quickly extinguishes a fire and maintains the safety of structures, systems and equipment at a nuclear reactor facility for power generation required to shut down the reactor(s) safely in the event of a fire. The system is comprised of fire retardant storage tanks, main piping and spray heads, etc.
- The reliability of fire suppression systems at a nuclear power station must be "equal, or better, than those of general industrial facilities" in accordance with the "Significance Classification Guidelines for Electrical and Mechanical Equipment Necessary for Safety"



Fire retardant storage tanks  
(Halide tanks)

Main pipes



Spray head ※

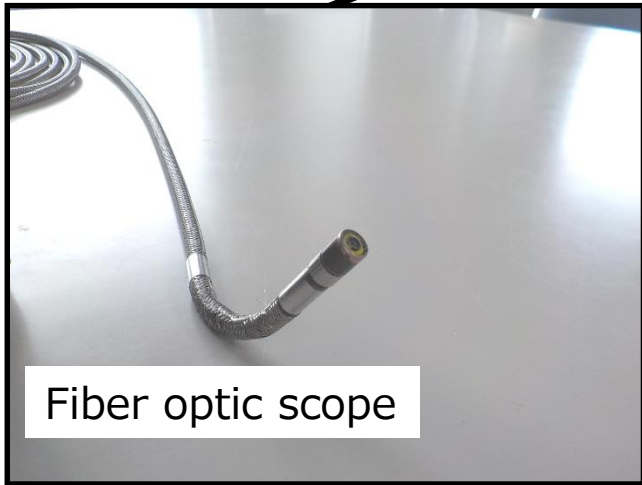
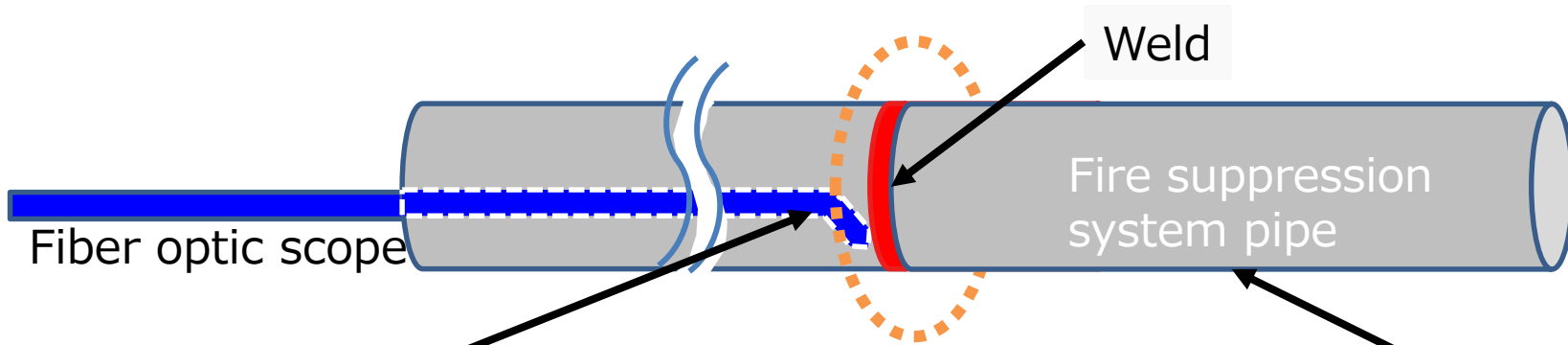
※ Fire retardant gas travels through the pipes and is sprayed from the spray head



Pipe weld

## <Diagram of inner pipe surface inspection>

Inner pipe weld inspection: Fiber optic scope is used to inspect the welds on the inside of the pipes since these areas cannot be seen directly.



Fiber optic scope

The flexible probe is 6.5 mm in diameter and attached to a cable approximately 7m in length. The camera head can be pointed in every direction



Fire suppression system pipe

# 3. Results of E&S's investigation into the allegations (1/5)

【Information obtained from interviews with welders from Company A: From E&S's report】



- **Many welders testified that "back shield gas is not used when welding" (9 out of 17 welders)**
  - ✓ During interviews conducted immediately after the allegations were made to E&S, welders at company A said that, "back shield gas is used" when welding together fire system pipes, **however during interviews conducted after July 7, many welders admitted that, "back shield gas is not used when welding."**
- It was discovered that **welders were falsifying weld records by automatically putting checkmarks in the column on the weld work instruction sheet (weld record) used for confirming that the first weld pass was being checked** without checking the integrity of the first weld pass.
- Some welders testified that even though a hose was connected to the pipes in order to purge them with a back shield gas, **"the back shield gas was not flowing. We were just pretending."**
- When asked when they stopped using a back shield gas, they estimated that it was "after September 2019," but they could not deny the possibility that a back shield gas had not been in use prior to that.

【Results of random inner pipe weld inspection: From E&S's report】

- A **random inner pipe weld inspection of 194** out of the 1,220 welds at Unit 7 performed by Company A, found **74 of the welds to be defective.**
  - ✓ The results of the random inner pipe weld inspection were confirmed by TEPCO as well as a third-party (JAPEIC)
  - ✓ Since the decision has already been made to redo all of the welds performed by Company A, an inner pipe weld inspection of the welds was not performed.



# (Reference 4) Inner weld conditions

Weld condition	Photo	Notes
Defective weld done by Company A		The weld on the inside of the pipe is covered with weld scales from oxidation
Good weld		No weld scales on the weld inside the pipe



#### 【Confirmed facts: From E&S's report】

- **In addition to not purging the pipes with a shield gas when welding, many of the welders at Company A were also falsifying weld records by automatically putting a check mark in the column on the weld work instruction sheet (weld record) used to confirm that the initial weld pass was checked.**
- The first welders that are thought to have started to weld inappropriately did so initially to finish their work quicker and avoid the trouble of having to bring in back shield gas tanks. This led them to ration shield gas; an action that eventually led to the habit of not purging the pipes with shield gas at all.
- These welders believed that there would be no problem with performance if the outside weld was robust even though they were not purging the pipe with shield gas, and therefore continued to weld inappropriately.
- Although some welders questioned this method, it was not viewed as a serious issue and the practice was conveyed to other welders. Eventually, at work sites run by Company A, intentionally not purging the pipes with shield gas and welding inappropriately became the norm.
- Even though welders were not purging the pipes, work supervisors from E&S and Company A were not checking inner welds, and were not instructing the welders to use back shield gas.
- **Work foreman and supervisors from Company A** had heard from some welders that **back shield gas was not being used,** but they are unaware of the importance of back shield gas and therefore **failed to make improvements in the field thereby allowing the inappropriate conditions persist.**

### 3. Results of E&S's investigation into the allegations (3/5)

#### [ Cause analysis of the inappropriate welding method: From E&S's report]

- Since the welds are class 3 welds, **E&S did not create a pipe welding plan and only gave general instructions** to “use back shield gas.”
- **The E&S Niigata branch office did not note detailed information, such as oxygen concentration control targets, etc., in the welding plan manual,** which is supposed to give detailed welding procedures and instructions, etc., **and left the welding method up to the subcontractors.**  
(Other E&S offices put procedures into writing and appropriately controlled oxygen concentrations.)
- Welders believed that there was no problem if their welds passed visual, penetration and pressure resistance tests, and prioritized work efficiency when deliberating whether or not to purge the pipes with shield gas. And, no innovative steps or revisions were implemented in regards to the scope of back purging when it came to welds for which back purging is not very effective.
- Company A work supervisors could not provide clear answers to alleviate welder concerns, and gradually welders came to realize that they couldn't count on supervisors to solve problems. This eventually led welders to make their own decisions and resulted in a failure on behalf of Company A to manage its workers.
- Although E&S work supervisors recognized that Company A work supervisors lacked skill and desired their replacement, they did not follow-up with action and Company A supervisors were not replaced. As a result, Company A supervisors were not able to ascertain the concerns of welders under their supervision.
- E&S work foremen believed that they could entrust [Company A] with welding since the welders are JIS certified, and since Company A work supervisors were completely dependent upon the skill and honesty of welders for guaranteeing quality in the field, they were unable to take corrective action in regards to inappropriate welding methods and falsified reports.
- Since the welding required was class 3, and there was an enormous amount of work, **E&S work supervisors did not directly** confirm that shield gas tanks were being used up and replaced, **and only checked welding records.**

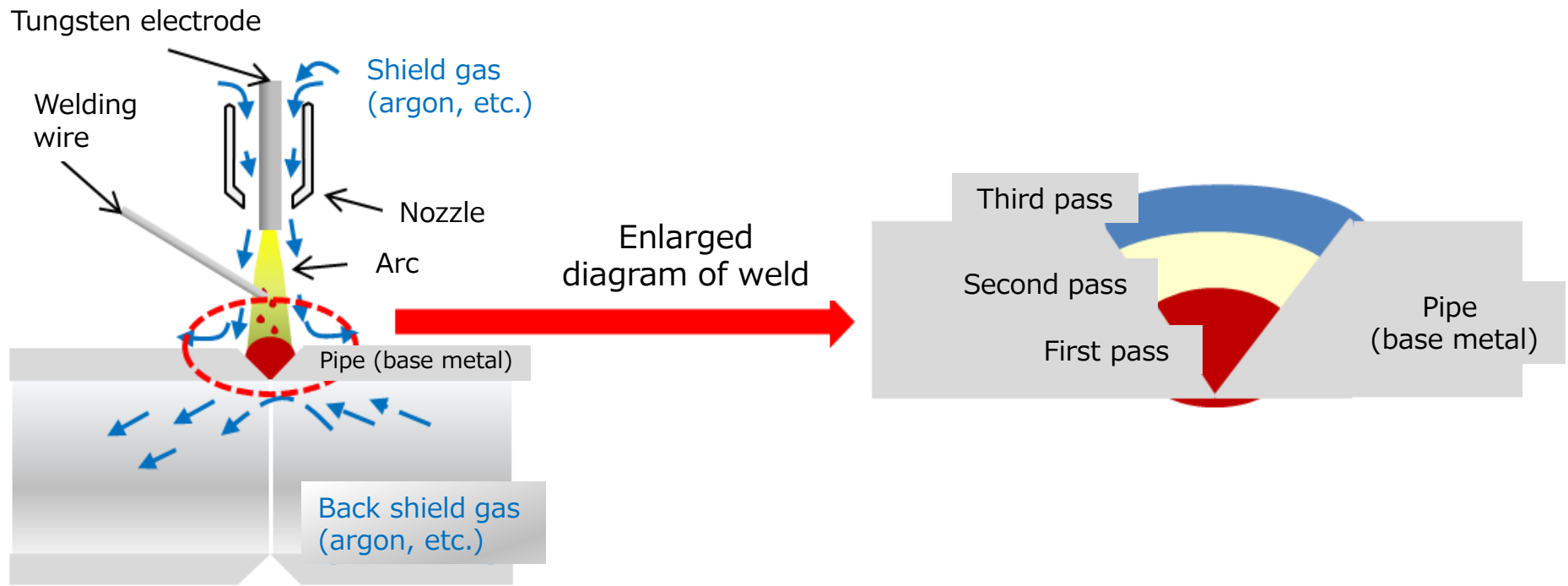
# 3. Results of E&S's investigation into the allegations (4/5)

## 【TEPCO's assessment and handling of the allegations】

- TEPCO attended interviews with persons of interest during E&S's investigation into the allegations, and verified the results of the random inner pipe weld inspection along with JAPEIC.
- TEPCO has deemed the facts verified by E&S, and E&S's cause analysis of the inappropriate welding practices, to be adequate.
- TEPCO **has identified the following serious issues related to this incident.**
  - ✓ **In addition to not purging pipes with shield gas when welding, many welders at Company A were also falsifying** weld records.
  - ✓ **Company A work supervisors and managers had heard** from some welders **that shield gas was not being used, but failed to make improvements in the field thereby allowing inappropriate conditions to persist.**
  - ✓ **The E&S Niigata branch office did not note details on oxygen concentration control targets, etc., in the weld management manual, and left welding methods up to the subcontractors.**
  - ✓ **E&S work supervisors** did not check the status of shield gas tank replacement and **only checked welding records thereby failing to adequately manage work in the field,** such as by directly checking welding work in the field.
- Since many of Company A's welders were welding inappropriately without back purging, TEPCO has instructed E&S to **redo all of the 1,220 welds done by Company A after thoroughly implementing recurrence prevention measures.**
- TEPCO has instructed E&S to conduct an investigation into the other welding companies used to weld the pipes for the Unit 7 fixed fire suppression system to ensure that similar practices were not employed by other subcontractors.

## [TEPCO integrity check of pipes welded inappropriately]

- In light of the fact that the allegations of inappropriate weld practices and falsified records have been confirmed, **TEPCO performed an integrity check of the 74 defective welds** found during the random inner pipe weld inspection and found the following.
  - ✓ Whereas oxidation was found on the first weld pass due to the lack of a back purging, the welds passed pressure resistance leak tests, penetration tests, and visual inspections.



\*Diagram of the three pass structure of welds

# 4. Unit 7 weld conditions and results of E&S's investigation (1/4)

## [Results of interviews with welders from companies B~F: From E&S's report]

- Six companies (A~F) welded the fixed fire suppression system piping at Unit 7
  - ✓ Many welders from Company A welded the pipes without the back purging ※1, but falsified records to indicate that back purging had been employed.
  - ✓ Companies B, C and D **back purged during welding, but did not sufficiently control oxygen concentrations** to confirm that the back purging was done correctly. (Oxygen concentration measurements were not sufficiently taken, or oxygen concentration meters were not used)
  - ✓ Company E employed appropriate welding practices by setting oxygen concentration criteria **upon creating a pipe welding plan in advance**, and back purging during welding while **measuring oxygen concentrations**.
  - ✓ Company F welds were done at the factory and oxygen concentrations were measured while back purging upon setting oxygen concentration criteria in advance. Pipes were shipped after passing quality control tests.
  - ✓ Interviews with multiple welders and a check of welding records indicated that companies B~F **back purged during welding and did not falsify records**.

	Back purging conducted	Oxygen concentration criteria set in advance	Oxygen concentrations measured
Company A	× ※1	×	×
Companies B, C, and D	○	×	× ※2
Company E	○	○	○
Company F	○	○	○

※1: Some welders back purged at their own discretion

※2: Some welders welded after measuring oxygen concentrations

## 4. Unit 7 weld conditions and results of E&S's investigation (2/4)

### [ Results of random inner pipe weld inspections on welds done by companies B~F: From E&S's report ]

- E&S, the general contractor, was responsible for a total of 3,846 welds at Unit 7 performed by six subcontractors (Companies A~F).
- All of the welds done by Company A (1,220 welds), which did not back purge and would be rewelded, and all of the welds done by Company F, which were done at the factory and passed quality control tests (953 welds), were omitted from the inspection.
- An inspection of the inner pipe welds performed by Companies B~E (4 companies) in accordance with the following rules found that **317 welds performed by Companies B, C, and D (3 companies) did not conform to order specifications.**
  - ① 10% of the welds done by each welder at each company were randomly selected for inner pipe weld inspection.
  - ② If any of the welds selected in ① were found not to conform to order specifications, an inspection of all the welds done by the welder that performed it was conducted.
  - ③ In light of the results of the random inner pipe weld inspection, all welds were inspected for Unit 7 just to be certain (1,673 welds).
- Furthermore, even though no problems were found with any welds inspected as part of ① (10% random inner pipe weld inspection)<sup>7</sup> for **Company E**, all of the welds were inspected just to be certain, and **no problematic welds were found.**  
(Thereby confirming the reliability of ① 10% random inner pipe weld inspection reliability)
- The results of the inner pipe weld inspection were confirmed by a third-party (JAPEIC) in addition to TEPCO.

Welding company	B	C	D	E	Total
Number of welds	<b>615</b>	<b>625</b>	<b>196</b>	<b>237</b>	<b>1,673</b>
Number of welds that did not conform to order specifications	<b>148</b>	<b>91</b>	<b>78</b>	<b>0</b>	<b>317</b>

## [Cause analysis of welds that do not conform to order specifications: From E&S's report]

<Reasons why some of the welds performed by companies B, C and D do not conform to order specifications. >

- Since the welds are class 3 welds, **E&S did not create a pipe welding plan and only gave general instructions** to “use back shield gas.”
  - ⇒ Same as allegations
- **The E&S Niigata branch office did not note detailed information, such as oxygen concentration control targets, etc., in the welding plan manual,** which is supposed to give detailed welding procedures and instructions, etc., **and left the welding method up to the subcontractors.**  
(Other E&S offices put procedures into writing and appropriately controlled oxygen concentrations.)
  - ⇒ Same as allegations
- E&S work managers did not think to instruct welding subcontractors to measure oxygen concentrations using oxygen concentration meters when back purging because they did not have enough experience.
- **Companies B, C and D** only received general instructions from the general contractor, **E&S, to “use back shield gas”, and did not sufficiently manage welding work.**
- **Welders tried to get back shield gas to be effective in locations where it is difficult to see any impact** from back shield gas, but **some welders welded based on their own experience even though the back shield gas was not effective.**
- Since the welding is class 3, and there was an enormous amount of work, **E&S work supervisors did not directly** confirm that shield gas tanks were being used up and replaced, **and only checked welding records.**
  - ⇒ Same as allegations



### [TEPCO's assessment and handling of the results of the investigation into Unit 7 fixed fire suppression system pipe welds]

- TEPCO attended interviews with persons of interest during E&S's investigation into the allegations, and verified the results of the random inner pipe weld inspection along with JAPEIC.
- TEPCO has deemed the facts verified by E&S, and E&S's cause analysis of the welds that do not conform to order specifications, to be adequate.
- TEPCO **has concluded that the general contractor did not fulfill its obligation to manage the welding process.**
- Company E employed appropriate welding practices by voluntarily setting oxygen concentration criteria **upon creating a pipe welding plan in advance**, and back purging during welding while **measuring oxygen concentrations**. As a result, none of the welds performed by Company E were problematic. Therefore, it is TEPCO's assessment that **all welding should have been managed in this manner.**
- **TEPCO** has performed an integrity check of the 317 welds that were found not to conform to order specifications that is the same as the integrity check performed for the 74 unsatisfactory welds found during the investigation into the allegations. (Refer to Slide 11).
- **TEPCO has instructed E&S to reweld all of the 317 welds performed by companies B, C and D that do not conform to order specifications upon thoroughly implementing recurrence prevention measures** so that weld quality required by TEPCO can be guaranteed over the mid/long-term.

### **【Root causes attributable to E&S, the general contractor (From E&S's report)】**

- Knowing that the weld work required was class 3 and would not be subject to pre-use operator inspections (welding inspections), **the E&S Niigata branch office outsourced the job to welding companies under the assumption that E&S welders need not be directly involved because the stainless steel pipe welding would be done appropriately by certified welders. As a result, it did not confirm the skill of the welding companies nor each welder.**
- Since the weld management manual from E&S's Welding and Inspection Center specifically mentions the use of back purging, **the E&S Niigata branch office thought that the welding would be done appropriately even though there was no specific details in the weld management manual just like the class 1 and 2 welding performed by in-house welders.**
- As a result, **the E&S Niigata branch office did not note details on oxygen concentration control targets, etc., in the weld management manual, and left welding methods up to the subcontractors.**
- **The E&S Niigata branch office failed to sufficiently supervise field work and did not build a robust work management system inclusive of welding subcontractors.**

### **【TEPCO's assessment of the root causes attributable to E&S】**

- TEPCO has found the root cause of this incident attributable to E&S to be adequate.
- TEPCO has concluded that the **root cause of this incident** is the fact that, **"the general contractor, E&S, failed to manage the welding process so that oxygen concentrations were measured against previously established oxygen concentration criteria while employing appropriate welding practices that include back purging."**

### 【Root causes attributable to the client, TEPCO】

- TEPCO believes that outsourcing the work was not the problem, but rather that, in light of the results of the investigation into these allegations, as the client in charge of operating and managing the nuclear power station, the following should have been checked.
  - ✓ TEPCO should have **checked the contents of the skill certification exam given to welders by E&S, and should have ascertained the details of the company's pipe welding plan.**
  - ✓ TEPCO **should have required E&S to include details on back purging and oxygen concentration control in the welding manual that it received from E&S, and confirmed that E&S was managing field work correctly in accordance with that manual.**
  - ✓ TEPCO should have **required the general contractor to develop, in advance, a pipe welding plan** that included directions to back purge when welding together stainless steel pipes.

### 【 The state of stainless steel pipe welds performed by E&S in the past at Unit 7 】

- In the wake of this incident an investigation of stainless steel pipe welds performed by E&S in the past at the TEPCO KK Nuclear Power Station Unit 7 was performed. The inner pipe weld inspection found that 11 out of 33 welds in the following equipment installed as part of voluntary safety improvement measures do not conform to order specifications.
  - ✓ Auxiliary facilities for the long-term stable cooling of Unit 7
- Whereas the aforementioned equipment has been installed as part of voluntary safety improvement measures, the decision has been made to reweld all the welds (43) made during the installation of this equipment in order to ensure that quality required by TEPCO can be guaranteed over the mid/long-term.

# 6. E&S's recurrence prevention measures

<Procurement management (From E&S's report) >

① Along with adding **compliance education** to the education that welders receive when they join the company (allegation countermeasure), **skill confirmation tests** for in-house certification **shall be strengthened** (Process management).

② When E&S selects a welding company it **shall confirm that work foremen and managers satisfy all requirements, such as having sufficient experience and the necessary qualifications** (Process management)

<Work management (From E&S's report) >

③ E&S work supervisors shall provide sufficient management education to work foreman working on the front lines, **strengthen field work management**, and drive home the importance of supervision (Process management)

④ E&S shall deliberate pipe designs in consideration of the ability to perform back purging when welding during the pipe design stage (Process management)

⑤ When welding stainless steel pipes together, a work manual shall be submitted to TEPCO upon clearly noting in it that **back purging is to be conducted, and back shield gas oxygen concentration control targets shall also be clearly stipulated**. (Process management)

⑥ The E&S Quality Management GM shall **cultivate safety culture** amongst E&S work foreman, welding company managers and work foremen, and welders, **through education provided during pre-review meetings, etc.** (Process management)

⑦ Prior to welding in the field, E&S welding managers, subcontractor work foremen, and welders shall deliberate the method for replacing back shield gas, and create a **Back Purge Gas System Configuration Plan** (Allegation countermeasure)

⑧ E&S shall **provide argon gas tanks to welding companies**, and **shall compare/confirm the actual amount of gas used with the total volume calculated** in the Back Purge Gas System Configuration Plan (Process management/Allegation countermeasure)

⑨ When welders make their first welding pass, they shall **confirm/record oxygen concentrations using an oxygen concentration meter** to ensure that oxygen concentrations meet control targets, and welding company work foremen shall supervise the measurements (Process management)

⑩ E&S welding managers shall supervise initial oxygen concentration measurements, and thereafter **perform random inspections during measurements**. Furthermore, after welding has been completed, **random inspections of inner pipe welds shall be conducted** (Allegation countermeasure)

# 7. Steps taken by TEPCO going forward

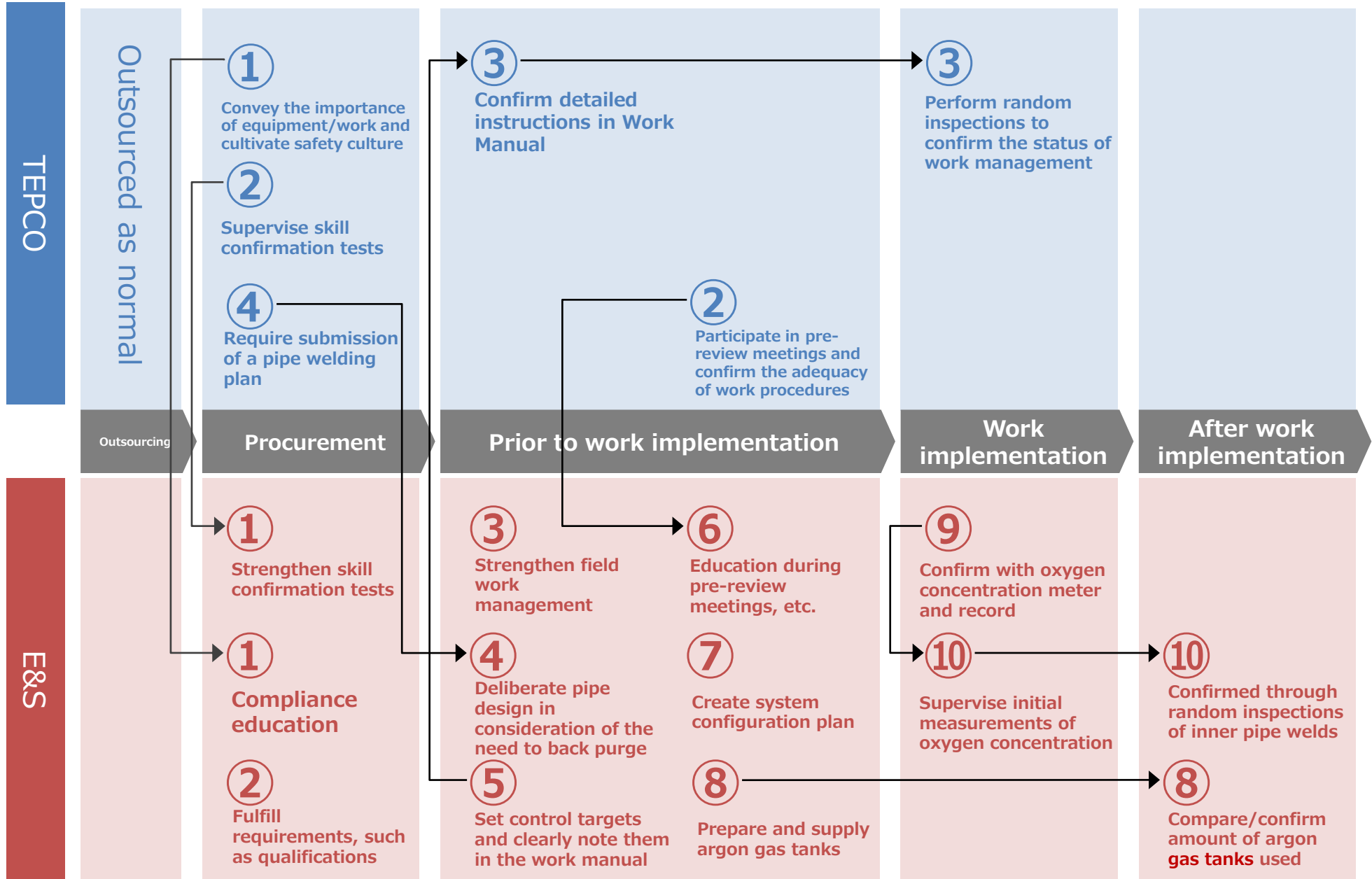
In order to operate/management nuclear power stations safely, strict action shall be taken in regards E&S to prevent a similar incident from happening again, and TEPCO shall implement its own countermeasures to prevent recurrence

## 【Strict action taken in regards to E&S】

- E&S has been asked to **thoroughly implement recurrence prevention measures** and to **reweld to specifications** all of the welds performed by companies B~D that are not up to order specifications, as well as all of the welds performed by Company A for which back purging was not employed.
- **The TEPCO Group shall suspend all outsourcing to E&S** ※ until it confirms that E&S's recurrence prevention measures are adequate. (Outsourcing suspended since the end of September 2021)  
 ※Excluding work for which outsourcing to E&S is unavoidable

## 【 TEPCO's recurrence prevention measures 】

- ① **The important role that equipment plays in nuclear safety and the importance of the work they perform shall be conveyed to field workers in order to cultivate safety culture amongst all individuals.**
- ② **For rewelding, TEPCO shall supervise the skill confirmation tests** that welders are subjected to by E&S, **and confirm skills/assessment status, as well as participate in pre-review meetings** to confirm E&S and welding company rewelding procedures/back purging plans, and create a system for **directly confirming the adequacy of welding procedures, etc.**
- ③ TEPCO shall confirm that the **welding manual, etc.,** it receives from general contractors, **clearly notes** back purging methods and oxygen concentration control, and it **shall perform random inspections to confirm that the general contractor is correctly managing welding work in the field in accordance with that manual.**
- ④ Going forward, TEPCO shall **require general contractors to submit a pipe welding plan** when welding class 3 stainless steel pipes together; a process that requires back purging.



## 8. Weld repair plan (reprinted)

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- All welds done by Company A for which back purging was not conducted (1,220 welds) and welds performed by companies B, C and D that are not up to order specifications (317 welds), shall be rewelded (total: 1,537 welds)
- In order to operate/management nuclear power stations safely, strict action shall be taken in regards E&S to prevent a similar incident from happening again, and TEPCO shall implement its own countermeasures to prevent recurrence.
- When rewelding, the effectiveness of recurrence prevention measures by E&S, the general contractor, shall be directly confirmed by TEPCO and a third-party (JAPEIC) while the rewelding work begins in January 2022.
- An inspection of Unit 6 shall be deliberated based upon the progress status of rewelding at Unit 7.